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(54) **MULTIFUNCTION CONTROLLER FOR A REMOTE CONTROLLED TOY**

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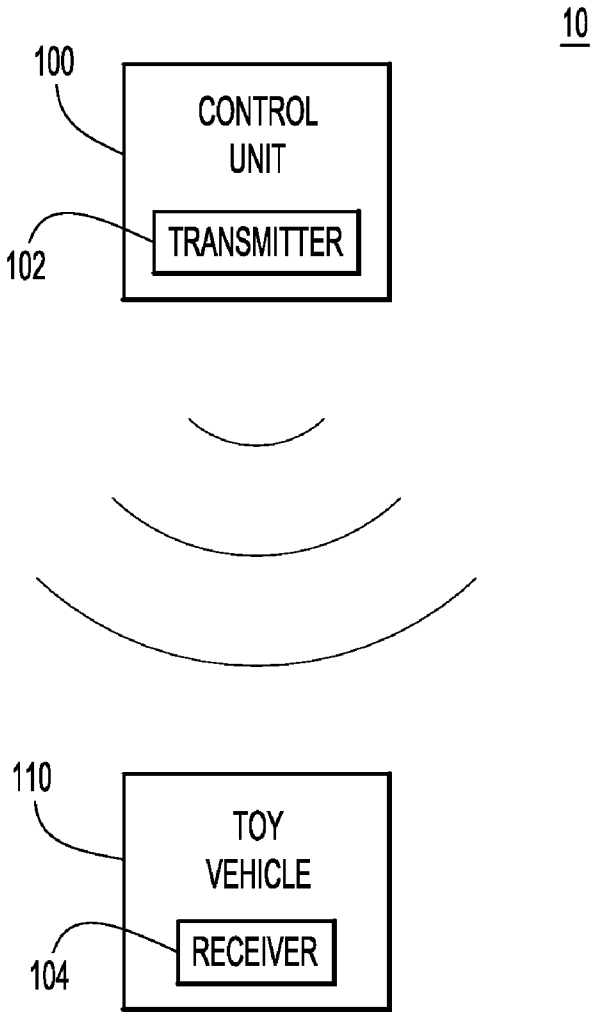
CPC ***A63H 30/02*** (2013.01); ***A63H 17/26*** (2013.01)

USPC **446/454**

(57) **ABSTRACT**

The present invention relates to a remote control assembly including a remote control unit and a toy vehicle. The remote control unit is a four function device that provides forward, reverse, forward-left, and forward-right inputs such that the selection of one input will cause the vehicle to move in a forward direction, the selection of a second input will cause the vehicle to move in reverse direction, the selection of a third input will cause the vehicle to move forward and left, and selection of the fourth input will cause the vehicle to move forward and right.



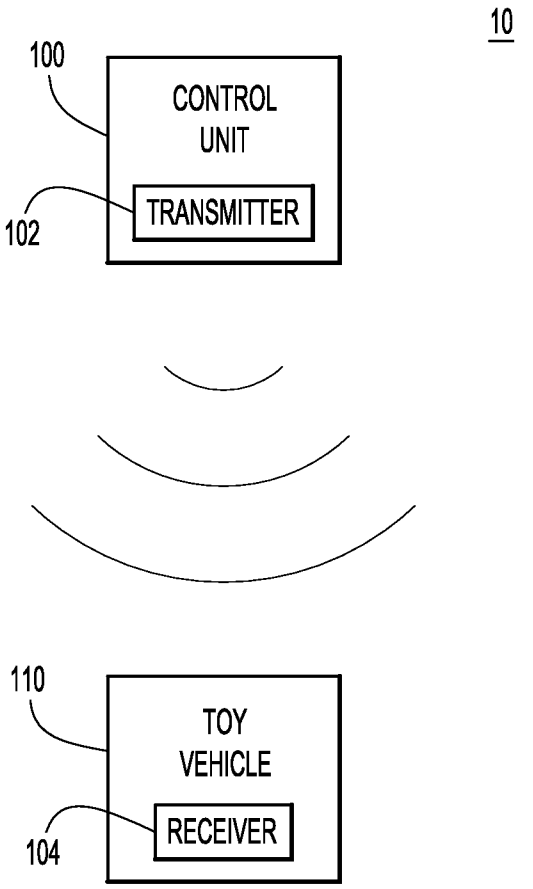

10
100
CONTROL UNIT
TRANSMITTER
102
110
TOY VEHICLE
RECEIVER
104

FIG.1

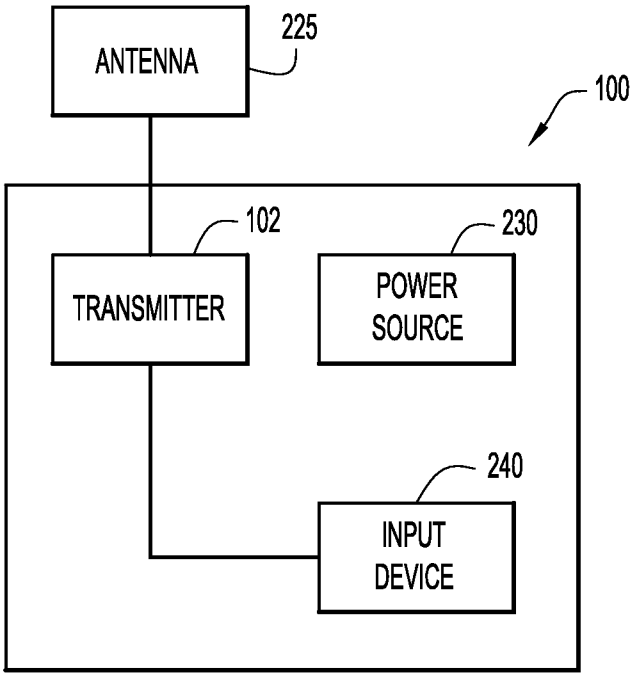

ANTENNA
225
100
102
230
TRANSMITTER
POWER SOURCE
240
INPUT DEVICE

FIG.2A

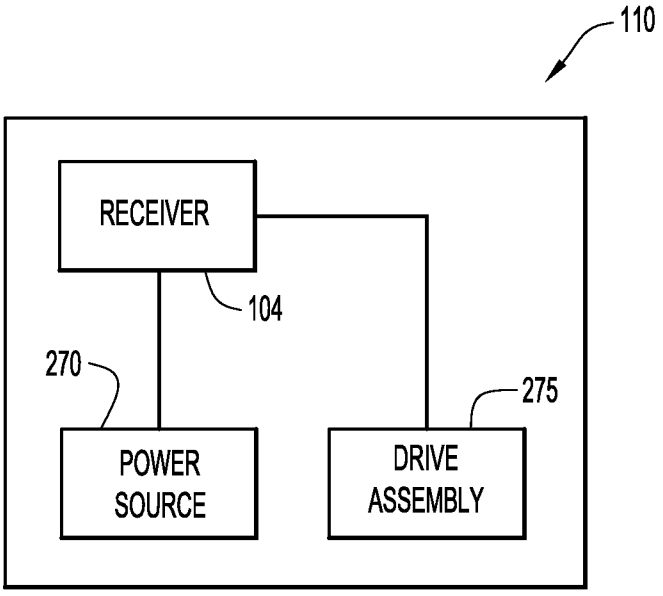

110
RECEIVER
104
270
275
POWER SOURCE
DRIVE ASSEMBLY

FIG.2B

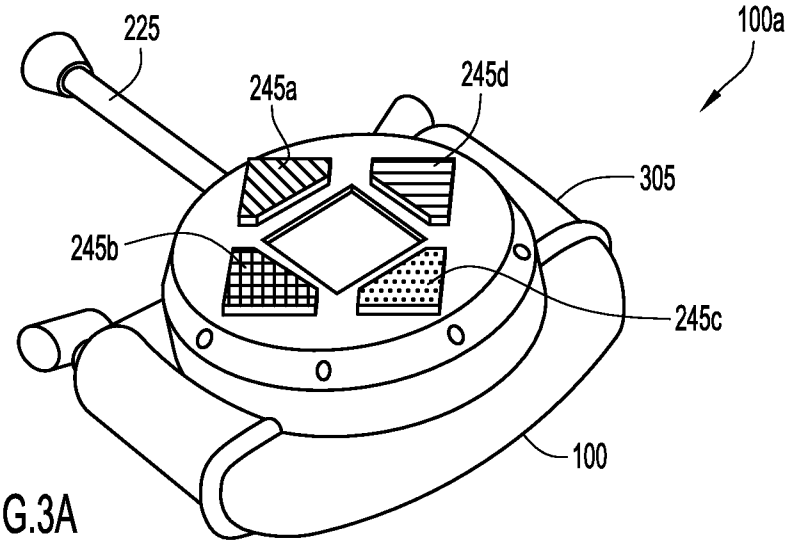

225
100a
245a
245d
305
245b
245c
100

FIG.3A

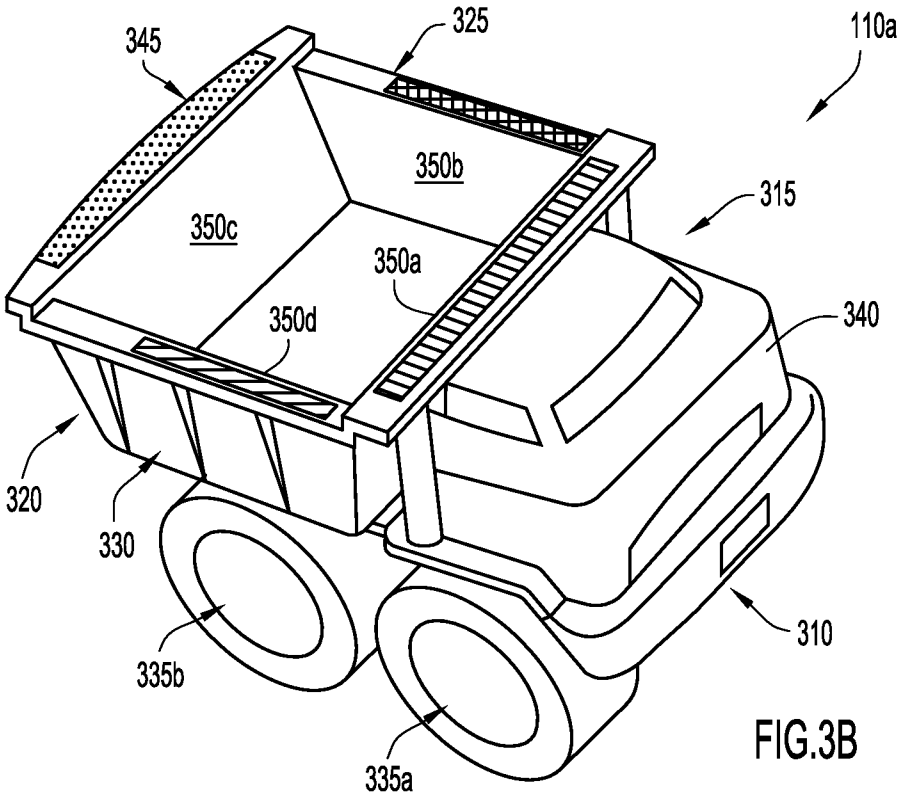

345
325
110a
350b
315
350c
350a
350d
340
320
330
335b
310
335a

FIG.3B

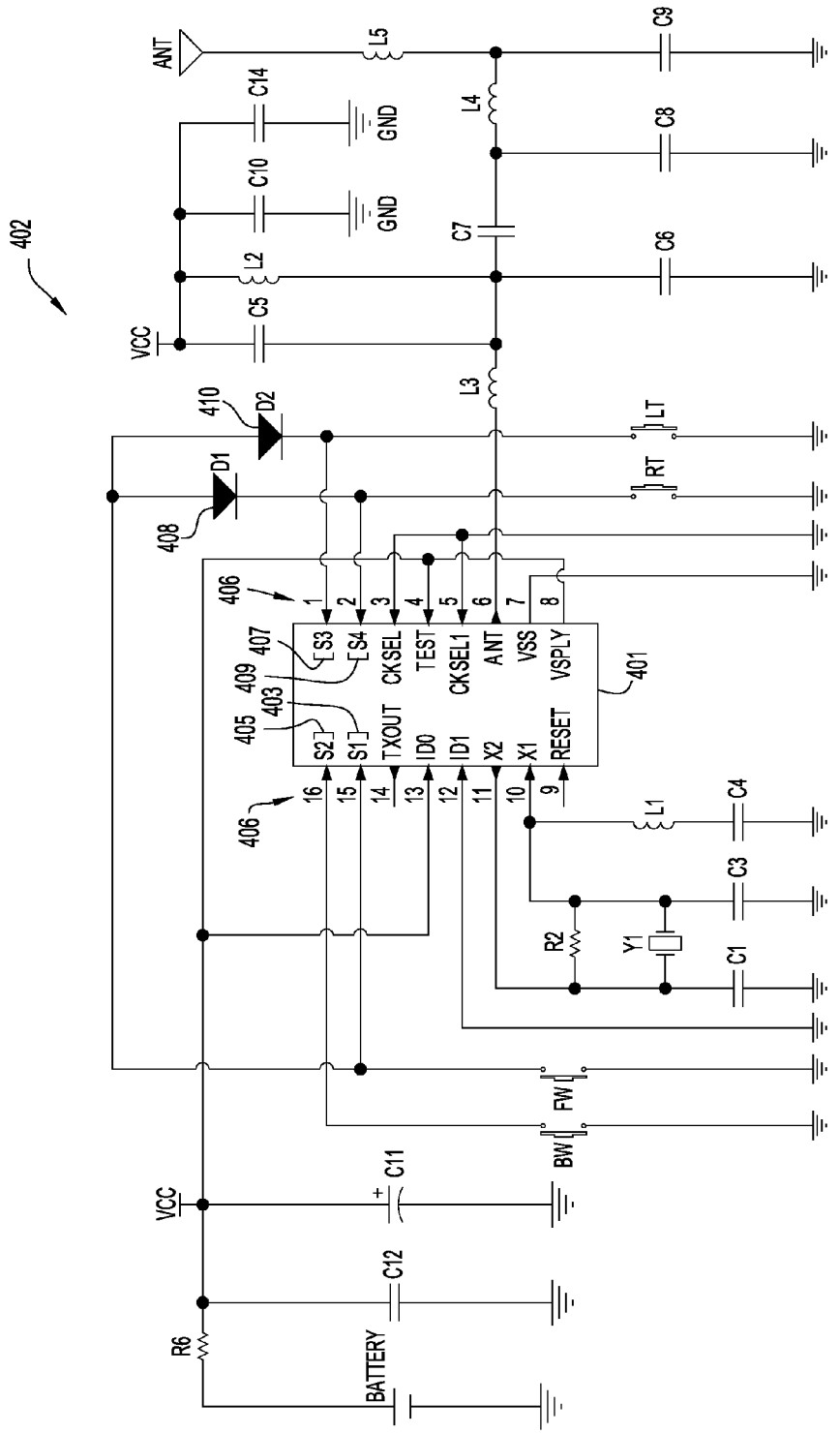
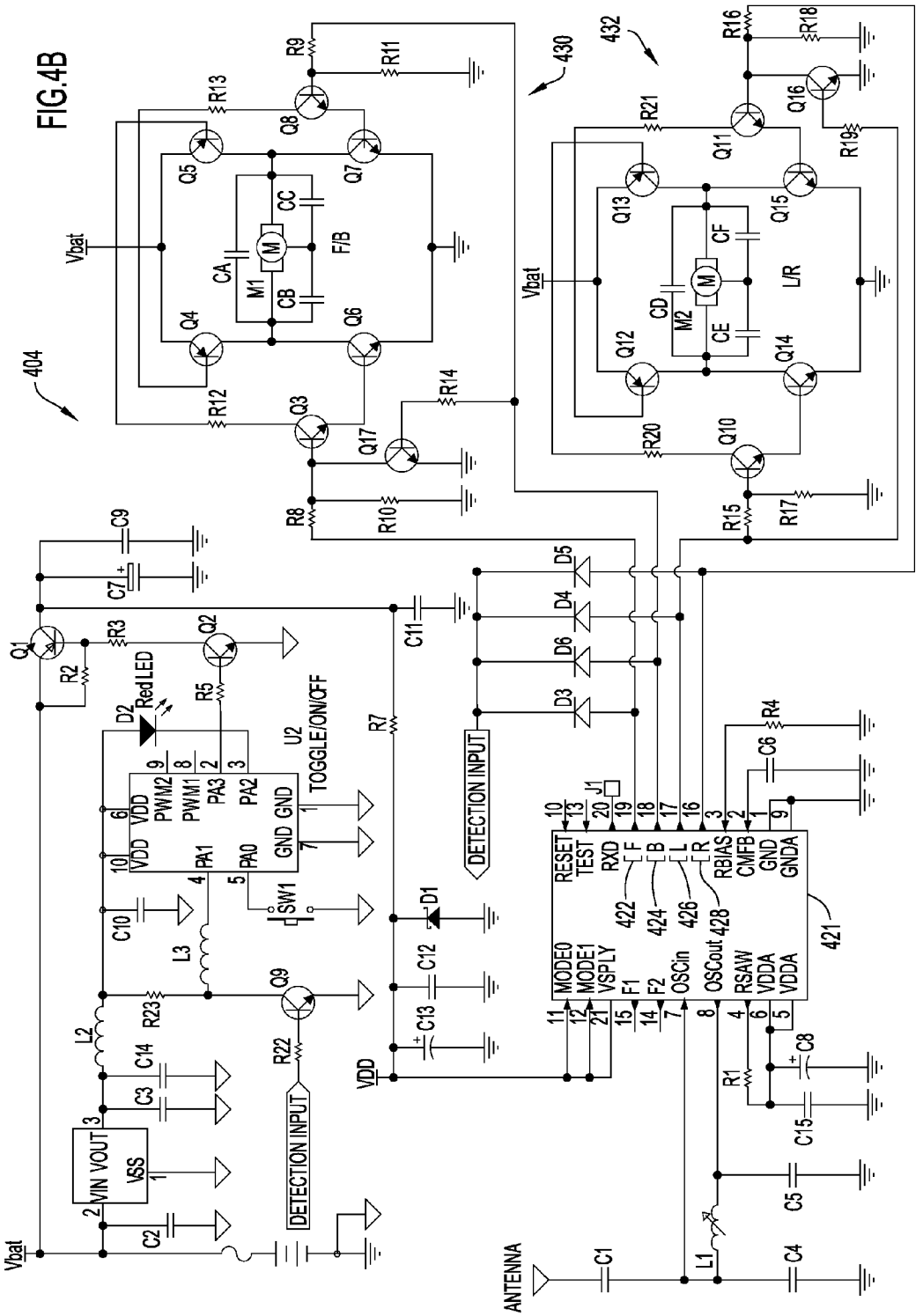

402
ANT
L5
C9
C14
GND
L4
C8
C10
GND
C7
C6
L2
C5
VCC
L3
410
D2
D1
408
LT
RT
406
407
409
403
405
S3
S4
CKSEL
TEST
CKSEL1
ANT
VSS
VSPLY
401
S2
S1
TXOUT
ID0
ID1
X2
X1
RESET
1
2
3
4
5
6
7
8
16
15
14
13
12
11
10
9
L1
C4
C3
R2
Y1
C1
FW
BW
VCC
C11
C12
R6
BATTERY

FIG.4A

FIG.4B


404
430
432
Vbat
F/B
L/R
CA
CB
CC
CD
CE
CF
M1
M2
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q17
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
C14
C15
L1
L2
L3
D1
D2
D3
D4
D5
D6
Red LED
SW1
U2
TOGGLE/ON/OFF
VDD
PWM2
PWM1
PA3
PA2
PA1
PA0
GND
VIN
VOUT
VSS
DETECTION INPUT
J1
RESET
TEST
RXD
F
B
L
R
RBIAS
CMFB
GNDA
MODE0
MODE1
VSPLY
F1
F2
OSCin
OSCout
RSAW
VDDA
421
422
424
426
428
ANTENNA

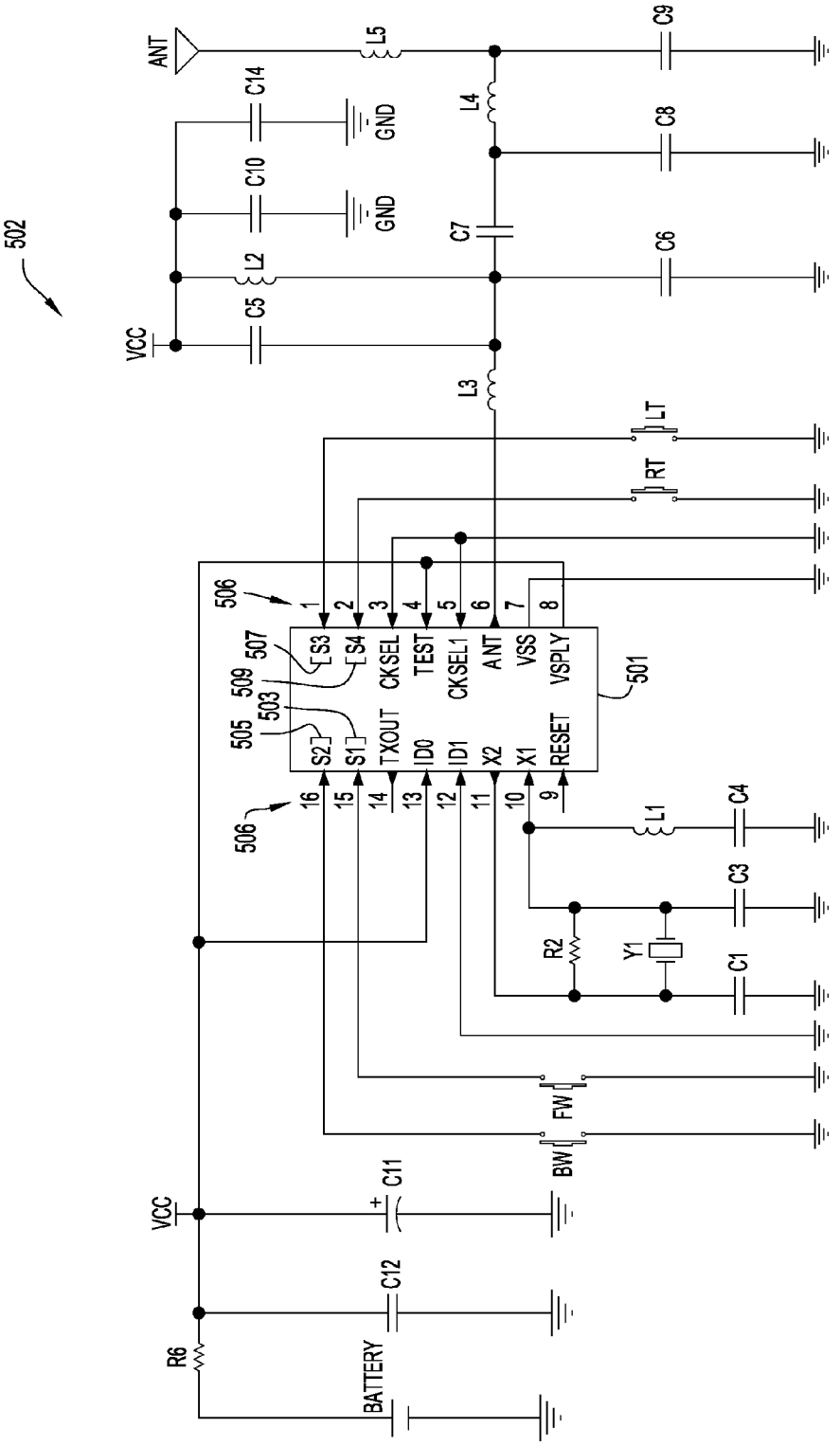
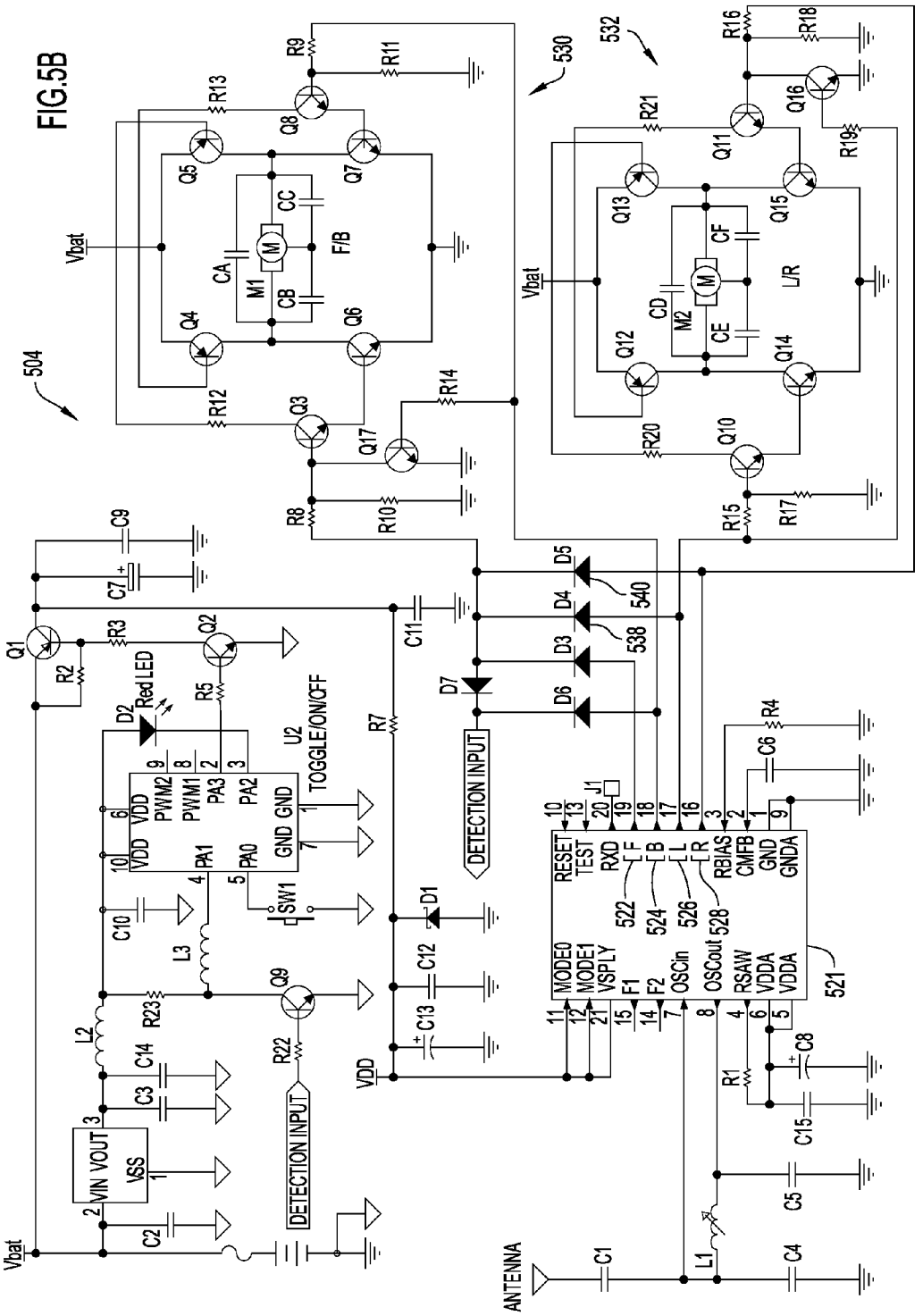

502
ANT
L5
C9
C14
GND
L4
C8
C10
GND
C7
C6
L2
C5
VCC
L3
LT
RT
506
507
509
503
505
S3
S4
CKSEL
TEST
CKSEL1
ANT
VSS
VSPLY
501
S2
S1
TXOUT
ID0
ID1
X2
X1
RESET
506
L1
C4
C3
R2
Y1
C1
FW
BW
VCC
C11
C12
R6
BATTERY

FIG.5A

FIG.5B


504
530
532
Vbat
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q17
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
C14
C15
CA
CB
CC
CD
CE
CF
M1
M2
F/B
L/R
L1
L2
L3
D1
D2
D3
D4
D5
D6
D7
Red LED
SW1
U2
TOGGLE/ON/OFF
VDD
PWM2
PWM1
PA3
PA2
PA1
PA0
GND
VIN
VOUT
VSS
DETECTION INPUT
J1
RESET
TEST
RXD
F
B
L
R
RBIAS
CMFB
GNDA
MODE0
MODE1
VSPLY
F1
F2
OSCin
OSCout
RSAW
VDDA
521
522
524
526
528
540
538
ANTENNA

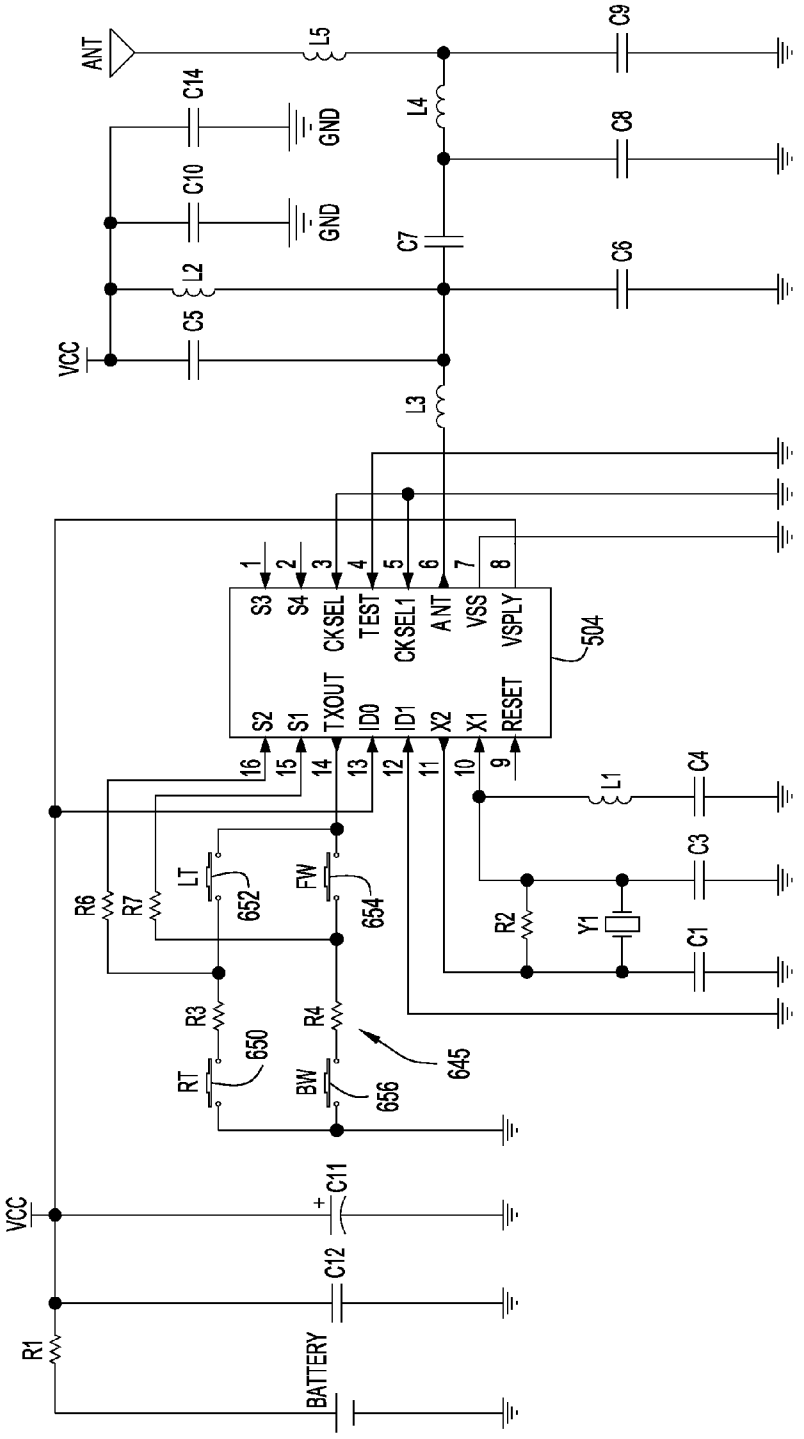
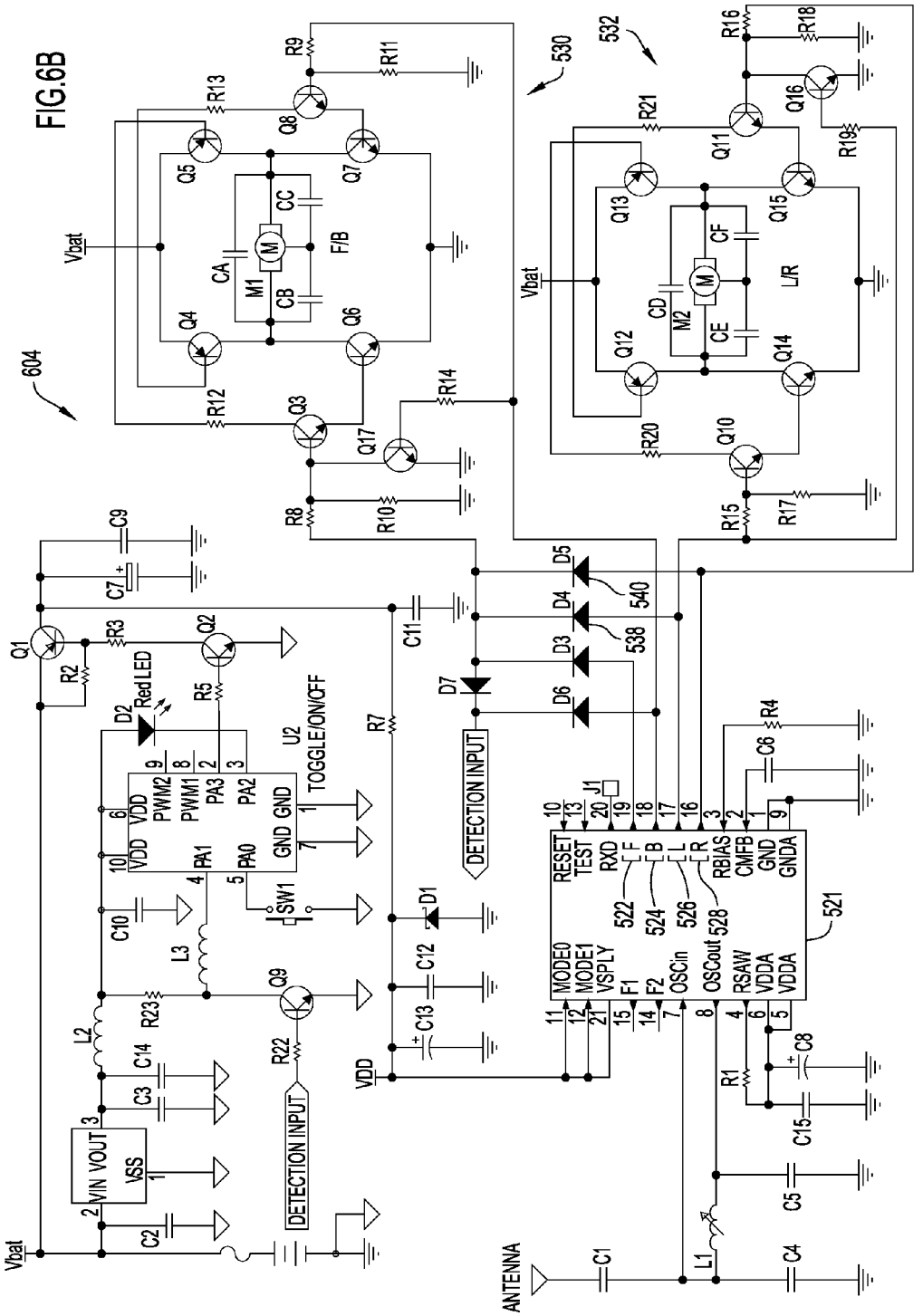

602
ANT
L5
C9
C14
GND
L4
C8
C10
GND
C7
C6
L2
C5
VCC
L3
1
2
3
4
5
6
7
8
S3
S4
CKSEL
TEST
CKSEL1
ANT
VSS
VSPLY
504
S2
S1
TXOUT
ID0
ID1
X2
X1
RESET
16
15
14
13
12
11
10
9
L1
C4
C3
R6
R7
LT
652
FW
654
R2
Y1
C1
R3
R4
650
645
RT
BW
656
VCC
C11
C12
R1
BATTERY

FIG.6A

FIG.6B


604
530
532
Vbat
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
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Q13
Q14
Q15
Q16
Q17
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
C14
C15
CA
CB
CC
CD
CE
CF
M1
M2
F/B
L/R
L1
L2
L3
D1
D2
D3
D4
D5
D6
D7
Red LED
SW1
U2
TOGGLE/ON/OFF
VDD
PWM2
PWM1
PA3
PA2
PA1
PA0
GND
VIN
VOUT
VSS
DETECTION INPUT
J1
RESET
TEST
RXD
F
B
L
R
RBIAS
CMFB
GNDA
MODE0
MODE1
VSPLY
F1
F2
OSCin
OSCout
RSAW
VDDA
521
522
524
526
528
540
538
ANTENNA

MULTIFUNCTION CONTROLLER FOR A REMOTE CONTROLLED TOY

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Application No. 61/885,086 entitled "MULTIFUNCTION CONTROLLER FOR A REMOTE CONTROLLED TOY," filed Oct. 1, 2013, the content of which is hereby incorporated by reference herein.

FIELD OF THE INVENTION

[0002] The present invention relates to a multifunction controller for a remote controlled toy.

BACKGROUND

[0003] Children are fascinated with the use of remote control toys/devices. Various types of systems exist in which toys (e.g., toy vehicles) are moved on a remotely controlled basis. Toy vehicles may include, for example, automobiles, trucks, tractors, construction vehicles, boats, airplanes, helicopters, etc. that move along a floor, a track, on water, or in the air. Most remote control devices, however, are geared toward older children that understand cause and effect and how it relates to the operation of the system.

[0004] It would be desirable to provide a system including a remotely controlled toy and a handheld controller that is easily utilized by a younger child.

SUMMARY

[0005] Embodiments of the present invention relate to a remote control assembly including a control unit and a toy vehicle. The control unit includes an input device configured to receive directional inputs from a user, and a signal transmitter (Tx) for transmitting control signals corresponding to the received directional/user input. The input device includes four input controls (e.g., buttons) that enable movement of the toy vehicle in a forward direction, a reverse direction, a forward-left direction, and a forward-right direction.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** illustrates a schematic diagram of a remote control assembly in accordance with an embodiment of the present invention.

[0007] FIG. **2**A is a block diagram of a control unit of the remote control assembly in accordance with an embodiment of the present invention.

[0008] FIG. **2**B is a block diagram of a toy vehicle of the remote control assembly in accordance with an embodiment of the present invention.

[0009] FIG. **3**A illustrates a perspective view of a control unit in accordance with an embodiment of the present invention.

[0010] FIG. **3**B illustrates a perspective view of a toy vehicle in accordance with an embodiment of the present invention.

[0011] FIG. **4**A is a schematic circuit diagram of a transmitter in a control unit in accordance with an embodiment of the present invention.

[0012] FIG. **4**B is a schematic circuit diagram of a receiver in a toy vehicle in accordance with an embodiment of the present invention.

[0013] FIG. **5**A is a schematic circuit diagram of a transmitter in a control unit in accordance with an embodiment of the present invention.

[0014] FIG. **5**B is a schematic circuit diagram of a receiver in a toy vehicle in accordance with an embodiment of the present invention.

[0015] FIG. **6**A is a schematic circuit diagram of a transmitter in a control unit in accordance with an embodiment of the present invention.

[0016] FIG. **6**B is a schematic circuit diagram of a receiver in a toy vehicle in accordance with an embodiment of the present invention.

[0017] Like reference numerals have been used to identify like elements throughout this disclosure.

DETAILED DESCRIPTION

[0018] FIG. **1** illustrates a remote control assembly in accordance with an embodiment of the present invention. As shown, the remote control assembly **10** includes a remote control unit or controller **100** and a remote controlled toy **110**. It is to be appreciated that the toy **110** may be one of a number of different toy devices (e.g., robots, vehicles, etc.). For ease of illustration, embodiments will be primarily described with reference to a remote controlled toy vehicle **110**.

[0019] The control unit **100** and the toy vehicle **110** are configured to wirelessly communicate via a transmitter **102** in the control unit **100** and a receiver **104** in the toy vehicle. In one embodiment, the control unit **100** transmits wireless commands to the toy vehicle **110** to engage one or more features of the vehicle (discussed in greater detail below). In another embodiment, both the control unit **100** and the toy vehicle **110** are configured to transmit command signals to and receive command signals from each other. As such, although a transmitter **102** and receiver **104** are shown in FIG. **1**, the transmitter **102** and receiver **104** may operate as transceivers (i.e., as both a transmitter and a receiver). However, for ease of illustration, embodiments will be primarily described herein with reference to the transmitter **102** wirelessly transmitting signals that are received by the receiver **104**.

[0020] The control unit **100** is, in general, a four-function controller that is configured to receive one of four inputs from a user. More specifically, the control unit **100** is configured to receive a directional input from a user and to transmit control signals corresponding to the received directional/user input. FIG. **2**A is a block diagram of the control unit **100** in accordance with embodiments presented herein. As shown, the control unit **100** includes the transmitter **102** in that can be any device capable of generating output signals for transmission to toy vehicle **110**. The transmitter **102** may be, for example, configured to transmit infrared (IR) signals, radio frequency (RF) signals, electromagnetic signals, ultrasonic signals, Bluetooth® signals, etc. The transmitter **220** may send signals via an optional antenna **225**.

[0021] The control unit **100** may further include a power source **230**. By way of example, the power source **230** may include a battery pack formed of one or more batteries. It should be understood, however, that any AC or DC power sources may be utilized. The controller **100** also includes an input device **240** that receives an external signal or that can be manipulated to generate a signal to be sent to the transmitter **102**. The input device **240** includes one or more input controls, such as depressible buttons. In operation, engaging an

input control of the input device **240** causes the transmitter **102** to generate a command/control signal and send it via the antenna **225**.

[0022] As described further below, the control unit **100** is a four function controller. That is, the input device **240** can only receive one or more of four available inputs (i.e., the input device **240** includes four input controls). There are many conventional simple and low-cost four function remote controlled vehicles currently available on the market. The four functions (inputs) available in these conventional devices are forward, reverse, steer left, and steer right.

[0023] As a result of the forward/reverse/left/right arrangement, conventional devices generally require a minimum of two inputs from the controller for the toy vehicle to initiate forward movement coupled with a turn function. For example, a user may have to push a forward button or lever while simultaneously pressing a second turn/steering button or lever (i.e., cause left/right steering with forward movement). However, it is very difficult for younger children to actuate two controls at the same time. In many cases, simply holding the controller requires young children to use two hands. As a result, when the difficulty of holding and activating the controller is combined with following and reacting to a moving vehicle, children often have little success operating the vehicle. Through child testing, it was found that if the forward and turn commands could be combined into a single button activation, the ease of operation can be greatly improved. Embodiments presented herein are generally directed to a solution that modifies commonly available, low cost radio (i.e., transmitter and/or receiver) integrated circuits (ICs) to implement two commands from a single button push by a user.

[0024] More specifically, the control unit **100** is a four function device that provides forward, reverse, forward-left, and forward-right inputs. In other words, in control unit **100** the selection of one input will cause the vehicle to move in a forward direction, the selection of a second input will cause the vehicle to move in reverse direction, the selection of a third input will cause the vehicle to move forward and left (forward-left), and selection of the fourth input will cause the vehicle to move forward and right (forward-right). As described further below, the dual functionality of the two inputs (i.e., forward-left and forward-right) is provided through specific hardware implementations in the transmitter **102** and/or receiver **104**.

[0025] The toy vehicle **110** is configured to move along a surface (e.g., a floor, water) or move above a surface (e.g., fly) in accordance with command signals received from the control unit **100**. FIG. **2**B is a block diagram of the toy vehicle **110** in accordance with embodiments presented herein. As shown, the toy vehicle **110** includes the receiver **104** which may be a device that is operable to receive signals from the transmitter **102** (e.g., a device configured to receive IR signals, RF signals, electromagnetic signals, ultrasonic signals, Bluetooth® signals, etc.

[0026] The toy vehicle **110** may further include a power source **270** and a drive motor assembly **275**. By way of example, the power source **270** may include a battery pack including one or more batteries. It should be understood, however, that other AC or DC power sources may be utilized. The drive motor assembly **275** includes one or more drive motors operable to drive the features of the toy vehicle and/or drive the movement of the vehicle. The drive motors may be any suitable motor for its described purpose. In one embodiment, the toy vehicle **110** includes two drive motors, one of which engages the forward wheels of the toy vehicle, and another that engages the rear wheels of the toy vehicle. In operation, the drive motor(s) move the toy vehicle in a direction or directions indicated by signals received at the receiver **104**.

[0027] FIG. **3**A illustrates a perspective view of one embodiment of the control unit, referred to as control unit **100***a*. FIG. **3**B illustrates a perspective view of one embodiment of the toy vehicle **100**, referred to as toy vehicle **110***a*. The control unit **100***a* comprises a housing **305** that includes the transmitter **102**. As shown, a plurality of actuators (e.g., depressible buttons) is coupled to the housing **305** and form the input device **240**. Specifically, the housing **305** includes a plurality of input controls or directional actuators **245***a*, **245***b*, **245***c*, and **245***d*. The directional actuators **245***a*, **245***b*, **245***c*, **245***d* are angularly spaced about housing **305** along an axis oriented generally perpendicularly to the axis of the antenna **225**. The actuators **245***a*, **245***b*, **245***c*, and **245***d* are spaced apart about a central region.

[0028] In an embodiment, engaging the first actuator **245***a* generates a command signal to initiate forward motion in the toy vehicle, engaging the second actuator **245***b* generates a command signal to initiate forward and first lateral (e.g., forward-left) motion in the toy vehicle, engaging the third actuator **245***c* generates a command signal to initiate rearward motion in the vehicle, and engaging the fourth actuator **245***d* generates a command signal to initiate forward and second lateral (e.g., forward-right) motion in the toy vehicle. The command signals, generated by transmitter **102** (FIGS. **1** and **2**A), are sent via the antenna **225**, which extends outward from the housing **305**. The control unit **100** may further include one or more light emitters such as a light emitting diode (LED) that selectively illuminate when a command is generated (i.e., when the control unit generates an instruction for the toy vehicle to move).

[0029] Referring to FIG. **3**B, the toy vehicle **110***a* includes a body or chassis **310** having a front portion **315**, a rear portion **320**, a first lateral/side portion **325**, and a second lateral/side portion **330**. In addition, the toy vehicle **110***a* includes one or more wheels rotatably coupled to the body **310**. In an embodiment, the toy vehicle **110***a* includes a pair of front wheels **335***a* (only one is shown) rotatably coupled to the front portion **315** of the body **310** and a pair of rear wheels **335***b* (only one is shown) rotatably coupled to the rear portion **320**. While illustrated as a dump truck having a cab **340** and an articulating, open box bed **345** defined by a forward wall **350***a*, a first side wall **350***b*, a rearward wall **350***c*, and a second side wall **350***d*, the toy vehicle **110***a* may be stylized as any suitable toy vehicle, including, but not limited to trains, cars, trucks, airplanes, helicopters, boats, space ships, etc.

[0030] The body **310** of the toy vehicle **110***a* houses the drive motor assembly **275** and the receiver **104** that receives control signals from the control unit **100***a* (explained above). The toy vehicle **110***a* may further include one or more light emitters such as a light emitting diode (LED) that selectively illuminates when a command is received from the control unit (e.g., when the toy vehicle receives instructions to move).

[0031] With the above described configuration, the toy vehicle **110***a* is movable in a forward direction, a reverse direction, a forward-left direction, and a forward-right direction in response to a corresponding control signal received from the input device. Specifically, by selectively engaging

the directional actuators **245***a*, **245***b*, **245***c*, **245***d* on the control unit **100***a*, a child can direct the motion of the toy vehicle **110***a*.

[0032] FIG. **4**A is a schematic circuit diagram illustrating one implementation of transmitter **102**, referred to as transmitter **402**. FIG. **4**B is a schematic circuit diagram illustrating one implementation of receiver **104**, referred to as receiver **420**, that is useable with transmitter **402** of FIG. **4**A. For ease of illustration, the embodiments of FIGS. **4**A and **4**B are described with reference to control unit **100***a* shown in FIG. **3**A and toy vehicle **110***a* shown in FIG. **3**B.

[0033] In the embodiments of FIGS. **4**A and **4**B, the transmitter **402** includes a hardware configuration that combines the two button functionality of conventional arrangements (i.e., the requirement to simultaneously press two buttons) into a single button press without requiring any software logic. Transmitter **402** includes an integrated circuit (IC) **404** that has a plurality of IC inputs (pins) **406**. A first input **403** (shown in FIG. **4**A as IC input S1) corresponds to forward motion of the toy vehicle **110***a*, a second input **405** (shown in FIG. **4**A as IC input S2) corresponds to reverse motion of the toy vehicle **110***a*, a third input **407** (shown in FIG. **4**A as IC input S3) corresponds to left lateral motion of the toy vehicle **110***a*, and a fourth input **409** (shown in FIG. **4**A as IC input S4) corresponds to right lateral motion of the associated toy vehicle **110***a*.

[0034] In accordance with embodiments of the present invention, a diode **408** (diode D1) is used to electrically couple the input S4 (corresponding to the right lateral motion) to the input S1 (corresponding to the forward motion). Additionally, a second diode **410** (diode D2) is used to electrically couple the input S3 (corresponding to the left lateral motion) to the input S1 (corresponding to the forward movement). As a result of the configuration shown in FIG. **4**A, if the "Right Turn" button (e.g., button **245***d* in FIG. **3**A) is pressed, input S4 is pulled low (connected to ground) and input S1 is also pulled low (through diode D1). This input combination causes the transmitter IC to send both the "Right Turn" and the "Forward" commands to the receiver **420** located in the toy vehicle **110***a*. If the "Left Turn" button (e.g., button **245***b*) is pressed, input S3 is pulled low (connected to ground) and input S1 is also pulled low (through diode D2). This input combination causes the transmitter IC to send both the "Left Turn" and the "Forward" commands to the receiver **420** located in the toy vehicle.

[0035] The receiver **420** has a configuration where, upon receiving and decoding the RF signals received from the transmitter **402**, the receiver IC **421** will switch outputs F (Forward) **422**, B (Reverse) **424**, L (Left Turn) **426**, and R (Right Turn) **428** between high and low based on the received commands. Outputs F and B are connected to an H-bridge **430** (common motor driving circuit allowing both forward and reverse motor operation) that provides power to the motor responsible for forward/reverse vehicle movement. Outputs L and R are connected to an H-bridge **432** that provides power to the motor responsible for turning the vehicle's front wheels left or right (steering motor). In the case of the example where both the "Forward" and "Left Turn" commands are received from transmitter **402**, output F **422** is switched high (raised to the IC supply value), output B **424** is switched low (ground), output R **428** is switched low and output L **426** is switched high. This enables the forward/reverse motor to spin in the forward direction and the steering motor to turn the front wheels to the left. As such, the toy vehicle travels both forward and left in response to a single button press at the controller.

[0036] As noted above, in the embodiments of FIGS. **4**A and **4**B, coupling diodes are added in the transmitter **402**. This may result in the need for a transmitter supply voltage that is greater than 2.1 volts (V), in the case where rectifier diodes are used. More specifically, there may be approximately 0.7 V drop across a rectifier diode and a typical IC input pin operates in response to a ⅔ transition of the input supply value (to ensure a solid read). Schottky diodes may be used in certain arrangements to lower the minimum required supply value.

[0037] FIG. **5**A is a schematic circuit diagram illustrating another implementation of transmitter **102**, referred to as transmitter **502**. FIG. **5**B is a schematic circuit diagram illustrating another implementation of receiver **104**, referred to as receiver **504**, that is useable with transmitter **502** of FIG. **5**A. The receiver **504** includes a hardware configuration configured to combine the two button functionality of conventional arrangements (i.e., the requirement to simultaneously press two buttons) into a single button press without requiring any software logic. For ease of illustration, the embodiments of FIGS. **5**A and **5**B are described with reference to control unit **100***a* shown in FIG. **3**A and toy vehicle **110***a* shown in FIG. **3**B.

[0038] In the embodiments of FIGS. **5**A and **5**B, the coupling diodes have been added to the receiver **520**. This removes any power supply restrictions on the transmitter. Additionally, the vehicle portion of a toy assembly typically includes more batteries (as a result of the two driving motors) than the transmitter so the additional voltage required by the coupling diodes is more easily handled in the vehicle circuitry.

[0039] In the embodiment shown in FIG. **5**A, the four input buttons: forward button **245***a*, reverse button **245***c*, left-forward button **245***b*, and right-forward button **245***d* are each connected directly to one of the input pins (inputs) of a transmitter IC **504**. More specifically, the forward button **245***a* is connected directly to input **503** (input S1), the reverse button **245***c* is connected directly to input **505** (input S2), the left-forward button **235***b* is connected directly to input **507** (input S3), and right-forward button **245***d* is connected directly to input **509** (input S4). Receiver **520**, includes a receiver IC **521** having a plurality of outputs, including outputs **522** (forward output or output F), **524** (back output, or output B), **526** (left output or output L), and **528** (right output or output R). The output L (Left Turn) of the receiver IC **521** is diode coupled through a diode **538** (diode D**4**) to the forward input (generally at resistor R**8**) of the forward/reverse H-bridge **530**. Output R (Right Turn) of the receiver IC **521** is also diode coupled through a diode **540** (diode D**5**) to the forward input of the forward/reverse H-bridge **530**. The F (Forward) output of the receiver IC **521** may need to be diode isolated from the cathodes of diodes D**4** and D**5** depending on the output configuration of the receiver IC. This is accomplished by reconfiguring the use of diode **542** (diode D**3**) from that shown for diode D**3** in receiver **420** of FIG. **4**B. This diode configuration has the added benefit of utilizing one fewer diode than is utilized in the embodiments of FIGS. **4**A and **4**B.

[0040] In one example, when an indication that the "Left Turn" button (e.g., button **245***b* in FIG. **3**A) has been pressed (i.e., a left turn command) is received by the receiver IC **521** in the vehicle, the output L will be switched high. This will cause the "steering" H-bridge **532** to turn the front wheels to

the left and will also result in a high signal (via diode D4) to be sent to the Forward input of the forward/reverse H-bridge **530**, thereby causing the vehicle to drive forward and turn left at the same time. When an indication "Right Turn" command is received by the receiver IC **521** in the vehicle, the output R will be switched high. This will cause the "steering" H-bridge **532** to turn the front wheels to the right and will also result in a high signal (via diode D5) to be sent to the forward input of the forward/reverse H-bridge **530**, causing the vehicle to drive forward and turn right at the same time.

[0041] FIG. **6**A is a schematic circuit diagram illustrating a still other implementation of transmitter **102**, referred to as transmitter **602**. FIG. **6**B is a schematic circuit diagram illustrating a still other implementation of receiver **104**, referred to as receiver **620**, that is useable with transmitter **602** of FIG. **6**A. In the example of FIG. **6**B, the hardware configuration of the receiver **620** is the same as that shown in FIG. **5**B (i.e., receiver **604** is the same as receiver **504**). As such, receiver **620** is shown in FIG. **6**B using the same reference numbers as used in FIG. **5**B. However, the hardware configuration of transmitter **602** is different from that of transmitter **502** (FIG. **5**A). For ease of illustration, the embodiments of FIGS. **6**A and **6**B are described with reference to control unit **100***a* shown in FIG. **3**A and toy vehicle **110***a* shown in FIG. **3**B.

[0042] The transmitter **602** includes a switch matrix **645** comprised of four input switches, namely: switch **650** (switch RT corresponding to "Right Turn"), switch **652** (switch LT corresponding to "Left Turn"), switch **654** (switch FW corresponding to "Forward"), and switch **656** (switch BW corresponding to "Reverse"). This configuration is useable when a matrix function known as a "six input function" is available. As a result of the configuration shown in FIG. **6**A, if the "Forward" button (e.g., button **245***a* in FIG. **3**A) and the "Reverse" button (e.g., button **245***c* in FIG. **3**A) are pressed at the same time, the transmitter IC will only transmit the "Forward" command to the vehicle. Additionally, if the "Left Turn" button (e.g., button **245***b* in FIG. **3**A) and the "Right" button (e.g., button **245***d* in FIG. **3**A) are pressed at the same time, only the "Left Turn" command (to cause both forward and left lateral movement) will be sent. This eliminates all possibilities of conflicting commands.

[0043] The hardware configurations of receivers **520** and **620** have an added benefit that, through the use of clamp transistor **560** (transistor Q**17** in the forward/reverse H-Bridge **530**), a more "advanced" reverse function can be provided. The clamp transistor Q**17** is placed in the design in the event that both the F ("Forward") and B ("Reverse") outputs are switched high at the same time. If this state occurs, transistor Q**17** is switched on, and clamps the forward side of the H-Bridge off (typically this is placed on the reverse side of the H-bridge so a failure mode results in forward function). As described above, the "Left Turn" and "Right Turn" functions are connected to the "Forward" function. As a result, it may not be possible to back-up and turn. However, by placing the clamp transistor Q**17** on the forward side of the forward/reverse H-Bridge **530**, if a reverse command is received first (thereby clamping the forward input off) and either a "Left Turn" or "Right Turn" command is received second, (the reverse button is pressed and held and the turn button is pressed second) the steering motor will move in the correct direction and the vehicle will back up and turn. The clamped forward input prevents the forward function from conflicting with the reverse drive. Therefore, as a child grows and can start to use two buttons to control functions, the child can also steer the vehicle in reverse. When used with the transmitter **602**, if both the "Forward" and "Reverse" buttons are pressed, the "Forward" button in the transmitter can be given the higher priority, thus causing the vehicle to go forward in the event of a conflict (the preferred default direction for children). Additionally, placing the clamp transistor Q**17** on the forward side of the H-Bridge allows for the combinations of the reverse button and turn button to result in a back-up steering function that can be discovered when the child is capable/ready.

[0044] While the present invention has been described in detail and with reference to specific embodiments thereof, it will be apparent to one skilled in the art that various changes and modifications can be made therein without departing from the spirit and scope thereof. For example, a remote control assembly in accordance with embodiments presented herein may be utilized in combination with various vehicles or other playsets. Such playsets may include a track having any number of individual track sections that can be coupled together in various combinations to form a continuous path on which a toy vehicle can travel. The playset may further include several objects related to the environment of the playset. For example, the playset can include one or more warning light structure, a gate crossing, and a ramp, a bridge, vehicle elevators, a construction crane, office buildings, etc.

[0045] Although the disclosed inventions are illustrated and described herein as embodied in one or more specific examples, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the scope of the inventions and within the scope and range of equivalents of the claims. In addition, various features from one of the embodiments may be incorporated into another of the embodiments. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the scope of the disclosure as set forth in the following claims.

[0046] It is to be understood that terms such as "left," "right," "top," "bottom," "front," "rear," "side," "height," "length," "width," "upper," "lower," "interior," "exterior," "inner," "outer" and the like as may be used herein, merely describe points or portions of reference and do not limit the present invention to any particular orientation or configuration. Further, terms such as "first," "second," "third," etc., merely identify one of a number of portions, components and/or points of reference as disclosed herein, and do not limit the present invention to any particular configuration or orientation.

1. A remote control assembly, comprising:

a toy vehicle including a body, at least one front wheel and at least one rear wheel rotatably coupled to the body, and a receiver; and

a control unit including an input device configured to receive inputs from a user, and a transmitter for transmitting control signals corresponding to the received user input to the receiver,

wherein a first single input received at the input device is configured to cause the toy vehicle to simultaneously move in both a forward and a first lateral direction and a second single input received at the input device is configured to cause the toy vehicle to move in a forward and a second lateral direction.

2. The remote control assembly of claim **1**, wherein the input device is a four-function device that only includes four

input controls comprising a forward button, a reverse button, a left button, and right button, and wherein depression of the left button causes both forward and left lateral movement of the toy vehicle and depression of the right button causes both forward and right lateral movement of the toy vehicle.

3. The remote control assembly of claim **2**, wherein the transmitter comprises an integrated circuit (IC) having at least four IC inputs, wherein a first IC input corresponds to forward movement of the toy vehicle, a second IC input corresponds to reverse movement of the toy vehicle, a third IC input corresponds to left lateral movement of the toy vehicle, and a fourth IC input corresponds to right lateral movement of the toy vehicle.

4. The remote control assembly of claim **3**, where the transmitter comprises:

a first diode electrically coupling the fourth IC input to the first IC input; and

a second diode electrically coupling the third IC input to the first IC input.

5. The remote control assembly of claim **4**, wherein upon a user activating the right button, the fourth IC input is directly connected to ground and the first IC input is connected to ground through the first diode such that the transmitter substantially simultaneously sends both a right turn command and a forward command to the receiver located in the toy vehicle, thereby causing substantially simultaneous forward and right lateral movement of the toy vehicle.

6. The remote control assembly of claim **4**, wherein upon a user activating the left button, the third IC input is directly connected to ground and the first IC input is connected to ground through the second diode such that the transmitter substantially simultaneously sends both a left turn command and a forward command to the receiver located in the toy vehicle, thereby causing substantially simultaneous forward and left lateral movement of the toy vehicle.

7. The remote control assembly of claim **3**, wherein the transmitter further includes a switch matrix comprised of four input switches each connecting one of the buttons to one or more of the IC inputs.

8. The remote control assembly of claim **3**, wherein the forward, reverse, left, and right buttons are connected directly to one of the inputs of the transmitter IC such that the receiver only receives one of a forward, reverse, right, or left command at any time in response to a user input, and wherein the receiver includes an IC having at least four IC outputs, wherein a first IC output corresponds to forward movement of the toy vehicle, a second IC output corresponds to reverse movement of the toy vehicle, a third IC output corresponds to left lateral movement of the toy vehicle, and a fourth IC output corresponds to right lateral movement of the toy vehicle.

9. The remote control assembly of claim **8**, wherein the receiver further comprises:

a third diode coupling the third IC output to a forward input of a forward/reverse H-bridge of the receiver; and

a fourth diode coupling the fourth IC output to the forward input of the forward/reverse H-bridge.

10. The remote control assembly of claim **9**, wherein upon receipt of a left turn command from the transmitter, the third IC output is switched to a high state causing the forward/reverse H-bridge to initiate forward movement of the toy vehicle and causing a left/right H-bridge of the receiver to initiate substantially simultaneous left lateral movement of the toy vehicle.

11. The remote control assembly of claim **9**, wherein upon receipt of a right turn command from the transmitter, the fourth IC output is switched to a high state causing the forward/reverse H-bridge to initiate forward movement of the toy vehicle and causing a left/right H-bridge of the receiver to initiate substantially simultaneous right lateral movement of the toy vehicle.

12. The remote control assembly of claim **9**, further comprising:

a clamp transistor positioned on the forward side of the forward/reverse H-Bridge.

13. A system, comprising:

a toy vehicle that includes a receiver; and

a remote control unit for the toy vehicle, wherein the remote control comprises:

a transmitter configured to wirelessly communicate with the receiver,

a four function input device comprising a first, a second, a third, and a fourth input control,

wherein activation of the second input control causes the toy vehicle to simultaneously move in both a forward and first lateral direction and wherein activation of the fourth input control causes the toy vehicle to simultaneously move in both a forward and a second lateral direction.

14. The system of claim **13**, wherein the transmitter comprises an integrated circuit (IC) having at least four IC inputs, wherein a first IC input corresponds to forward movement of the toy vehicle, a second IC input corresponds to reverse movement of the toy vehicle, a third IC input corresponds to left lateral movement of the toy vehicle, and a fourth IC input corresponds to right lateral movement of the toy vehicle.

15. The system of claim **14**, where the transmitter comprises:

a first diode electrically coupling the fourth IC input to the first IC input; and

a second diode electrically coupling the third IC input to the first IC input.

16. The system of claim **15**, wherein upon activation of the fourth input control, the fourth IC input is directly connected to ground and the first IC input is connected to ground through the first diode such that the transmitter substantially simultaneously sends both a right turn command and a forward command to the receiver located in the toy vehicle, thereby causing substantially simultaneous forward and right lateral movement of the toy vehicle.

17. The system of claim **15**, wherein upon activation of the second input, the third IC input is directly connected to ground and the first IC input is connected to ground through the second diode such that the transmitter substantially simultaneously sends both a left turn command and a forward command to the receiver located in the toy vehicle, thereby causing substantially simultaneous forward and left lateral movement of the toy vehicle.

18. The system of claim **14**, wherein the transmitter further includes a switch matrix comprised of four input switches each connecting one of the input controls to one or more of the IC inputs.

19. The system of claim **14**, wherein each of the input controls are connected directly to one of the inputs of the transmitter IC such that the receiver only receives one of a forward, reverse, right, or left command at any time in response to a user input, and wherein the receiver includes an IC having at least four IC outputs, wherein a first IC output

corresponds to forward movement of the toy vehicle, a second IC output corresponds to reverse movement of the toy vehicle, a third IC output corresponds to left lateral movement of the toy vehicle, and a fourth IC output corresponds to right lateral movement of the toy vehicle.

20. The system of claim **19**, wherein the receiver further comprises:

a third diode coupling the third IC output to a forward input of a forward/reverse H-bridge of the receiver; and

a fourth diode coupling the fourth IC output to the forward input of the forward/reverse H-bridge.

21. The remote control assembly of claim **20**, wherein upon receipt of a left turn command from the transmitter, the third IC output is switched to a high state causing the forward/reverse H-bridge to initiate forward movement of the toy vehicle and causing a left/right H-bridge of the receiver to initiate substantially simultaneous left lateral movement of the toy vehicle.

22. The remote control assembly of claim **20**, wherein upon receipt of a right turn command from the transmitter, the fourth IC output is switched to a high state causing the forward/reverse H-bridge to initiate forward movement of the toy vehicle and causing a left/right H-bridge of the receiver to initiate substantially simultaneous right lateral movement of the toy vehicle.

23. A method for controlling movement of a toy vehicle with a remote control unit that comprises a four function input device including a first, a second, a third, and a fourth input control, the method comprising:

receiving a user input activating only a single one of the control inputs of the input device;

based on the activation of the single control input, generating one or more control signals indicating a selected direction of movement for the toy vehicle;

sending the one or more control signals from the remote control unit to the toy vehicle; and

initiating movement of the toy vehicle in accordance with the one or more control signals such that the toy vehicle simultaneously moves in both a forward and a lateral direction.

24. The method of claim **23**, wherein generating the one or more control signals indicating a selected direction of movement for the toy vehicle comprises:

generating a first and a second control signal, wherein the first control signal indicates a forward movement of the toy vehicle and the second control signal indicates a selected lateral movement of the toy vehicle.

25. The method of claim **24**, wherein the remote control unit comprises:

a transmitter integrated circuit (IC) having at least four IC inputs, wherein a first IC input corresponds to forward movement of the toy vehicle, a second IC input corresponds to reverse movement of the toy vehicle, a third IC input corresponds to left lateral movement of the toy vehicle, and a fourth IC input corresponds to right lateral movement of the toy vehicle;

a first diode electrically coupling the fourth IC input to the first IC input; and

a second diode electrically coupling the third IC input to the first IC input.

26. The method of claim **23**, wherein generating the one or more control signals indicating a selected direction of movement for the toy vehicle comprises:

generating a single control signal comprising one of a forward, a reverse, a right, or a left command.

27. The method of claim **26**, wherein the toy vehicle comprises:

a receiver IC having at least four IC outputs, wherein a first IC output corresponds to forward movement of the toy vehicle, a second IC output corresponds to reverse movement of the toy vehicle, a third IC output corresponds to left lateral movement of the toy vehicle, and a fourth IC output corresponds to right lateral movement of the toy vehicle;

a third diode coupling the third IC output to a forward input of a forward/reverse H-bridge of the receiver; and

a fourth diode coupling the fourth IC output to the forward input of the forward/reverse H-bridge.

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